

ESO 422-G028: THE HOST GALAXY OF A GRG

M. Jamrozy¹ J. Kerp¹ U. Klein¹ K.-H. Mack^{2,1} and L. Saripalli³

¹ *Radioastronomisches Institut der Universität Bonn, Auf dem Hügel 71, D-53121 Bonn, Germany*

² *Istituto di Radioastronomia, Via P. Gobetti 101, I-40129 Bologna, Italy*

³ *Australia Telescope National Facility, Locked Bag 194, Narrabri NSW 2390, Australia*

Received: xx October 2003

Abstract. ESO 422-G028 denotes the very center cD-galaxy of the giant radio source B0503-286 (Saripalli et al. 1986, Subrahmanya & Hunstead, 1986). The angular extent of the associated radio structure is about 42', which corresponds to a linear size of 1.89 Mpc (with $\Omega_M = 0.27$, $\Omega_\Lambda = 0.73$, and $H_0 = 71 \text{ km s}^{-1} \text{ Mpc}^{-1}$). Here we present new high-frequency total-power and polarization radio maps obtained with the Effelsberg 100-m dish. In addition, we correlate the radio data with optical and X-ray observations to investigate the physical conditions of both, the host galaxy and the extended structure.

Key words: Galaxies: active, individual: ESO 422-G028 – Radio continuum: galaxies

1. HOST GALAXY

The giant radio galaxy (GRG) B0503-286 is hosted by a massive galaxy ESO 422-G028 which has a redshift of 0.0381. The galaxy has a mean size of about 60 kpc and is the largest member of a poor galaxy cluster. Its optical apparent B and R magnitudes (taken from the Lyon-Meudon Extragalactic Data Base) are 14^m.62 and 13^m.01, respectively. Trifalencov (1994) found that the galaxy contains a huge ($10^6 - 10^7 M_\odot$) amount of warm (35–50 K) dust. Veron-Cetty & Veron (2000) found that the nucleus of ESO 422-G028 has a low luminosity and hence classified this galaxy as a LINER type. A low-resolution optical spectrum taken by Subrahmanya & Hunstead (1986) and by Saripalli et al. (1986) does not show any H β and [OIII] emission lines, both are typical for powerful radio galaxies.

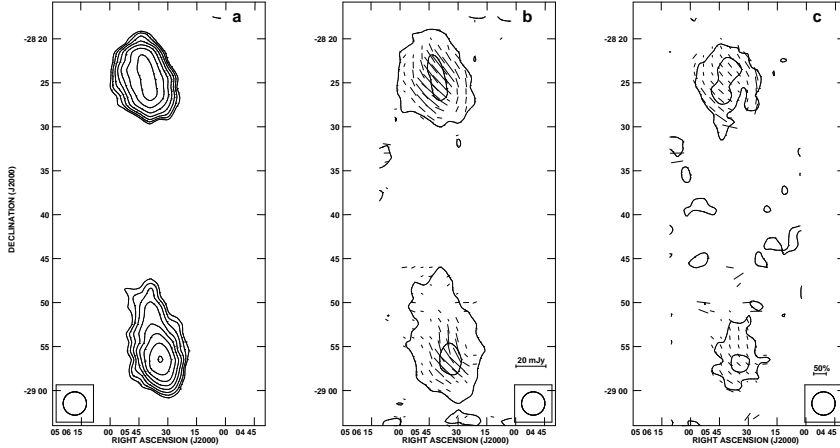


Fig. 1. Radio maps of the source B0503-286 at $\lambda 6.3$ cm. **a:** Total intensity contours of 1, $\sqrt{2}$, 2, ..., $\sqrt{2}^7 \times 10$ mJy/beam. **b:** Magnetic field B-vectors, with their length proportional to the polarized intensity, superimposed with 5 and 80 mJy/beam total intensity contours. **c:** Linearly polarized intensity contours of 3 and 12 mJy/beam, with the vectors of the fractional linear polarization superimposed. The scales of the polarization vectors are indicated by the bars and the beam size by the circles in the lower corners of the maps.

2. HIGH FREQUENCY RADIO EMISSION

The radio source B0503-286 consists of a weak core-jet structure ($S_{1.4\text{ GHz}} \sim 12$ mJy), well visible in the NVSS map (Condon et al. 1998), as well as of two prominent radio lobes elongated north-south ($S_{1.4\text{ GHz}} \sim 2.5$ Jy). Morphologically it is a standard FR II-type (Farnoff & Riley 1974), but because of its rather low total radio luminosity ($\log L_{1.4\text{ GHz}} = 25.2 \text{ W Hz}^{-1}$) it has to be classified as a FRI/FRII transient type (Owen & Ledlow 1994).

Here we report new high-frequency measurements of the radio giant, carried out with the Effelsberg 100-m telescope. The $\lambda\lambda$ 6.3 and 2.8 cm observations are essentially free of Faraday effects and hence allow us to directly map the intrinsic magnetic field structure and polarization characteristics of the source. In addition, the high-frequency maps (see Fig. 1) emphasize the most active parts of the radio galaxy which are very important when studying particle ageing. The linear polarization maps reveal a significant increase of the fractional polarization as well as a tangential magnetic field struc-

ture in the region of the hot spots. Furthermore, the lobes show high and almost equal fractional polarization, which is almost constant at both frequencies. Integrating the Stokes Q and U maps yields a fractional polarization of B0503-286, of ~ 12 per cent, which is almost twice the median value that comes from the B3-VLA sample of radio sources (Klein et al. 2003). The ratio of the lobe flux densities is about unity at low as well as at high frequencies. The spectral index α ($S \sim \nu^{-\alpha}$) of the northern and southern lobe is 1.14 and 1.05, respectively. We do not detect any radio emission from the core of B0503-286 at $\lambda 6.3$ cm. However, we manage to measure its flux density at $\lambda 2.8$ cm. The resulting spectral index of the core between $\lambda \lambda$ 21 cm and 2.8 cm is 0.34.

Table 1. High-frequency radio flux-densities of the total source and its components.

λ [cm]	Flux [Jy]			
	Total	N-lobe	S-lobe	Core
6.3	0.681 ± 0.038	0.346 ± 0.028	0.335 ± 0.026	-
2.8	0.369 ± 0.011	0.193 ± 0.008	0.170 ± 0.008	0.006 ± 0.002

3. X-RAY EMISSION AND INTERGALACTIC MEDIUM

We retrieved *ROSAT* PSPC observations toward the source B0503-286 from the public *ROSAT* archive. The total exposure time of the observation is 21,825 s. The photon events were binned into the standard C, M and J *ROSAT* energy bands (for details see Kerp et al. 2002). We classified an X-ray source as detected if the number of net counts exceeded the 3σ threshold above the noise set by the background level. We integrated the X-ray photons of each individual source within a circular area with a diameter equal to $1''.0$ for each individual energy band. From this total number of photons we subtracted the contribution of the X-ray background (XRB) emission. In total, we detected 27 significant X-ray sources within the boundaries of the radio giant. Their positions are marked in Fig. 2. as circles. The circles with a cross mark X-ray sources which lack optical counterparts brighter than $R = 19^m$ and which might be physically connected with the radio structure of the northern lobe. In addition, we manage to detect X-ray emission from the host galaxy (which is marked with an arrow in Fig. 2).

Contrary to the symmetries of the radio structure mentioned above, the overall (projected) high-frequency morphology of B0503-286 is asymmetric in terms of the core-lobe arm-length ratio (~ 2) and the lobe morphology. The asymmetry of the radio giant could be caused by inhomogeneities in the ambient intergalactic medium, which is supported by the distribution of soft X-ray emission sources that show a significant excess in number density around the northern lobe. In addition, it seems that the brightest optically visible field galaxies tend to concentrate near the position of the host galaxy and in the vicinity of the northern lobe.

ACKNOWLEDGMENTS.

MJ acknowledges the financial support from EAS.

References

- Condon J. J., Cotton W. D., Greisen E. W., et al. 1998, *AJ*, 115, 1693
 Fanaroff B. L., Riley J. M. 1974, *MNRAS*, 167, 31
 Kerp J., Walter F., Brinks E. 2002, *ApJ*, 571, 809
 Klein U., Mack K.-H., Gregorini L., Vigotti M. 2003, *A&A*, 406, 579
 Owen F. N., Ledlow M. J. 1994, in *The First Stromlo Symposium: The Physics of Active Galaxies*, ASP Conf. Ser. 54, eds. G. V. Bicknell, M. A. Dopita, & P. J. Quinn, p. 319
 Saripalli L., Gopal-Krishna, Reich W., Kühr H. 1986, *A&A*, 170, 20
 Subrahmanya C. R., Hunstead R. W. 1986, *A&A*, 170, 27
 Trifalenkov I. A. 1994, *AstL*, 20, 215
 Veron-Cetty M. P., Veron P. 2000, *A Catalogue of Quasars and Active Galactic Nuclei (9th Ed.)*

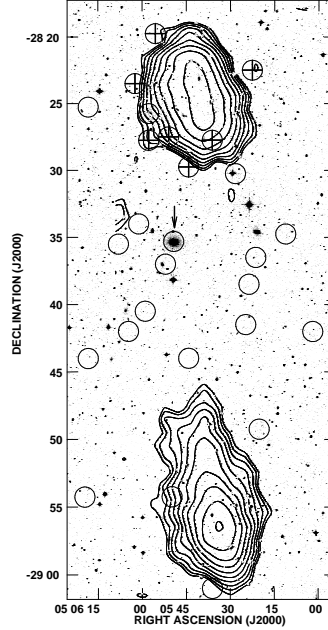


Fig. 2. Positions of X-ray sources marked as circles (for details, see the text), superimposed on a gray-scale optical image and contours of the 6.3 cm radio emission.